RDT

Brief

Research Investigation 01-053
Research Report 03-006

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Vertical Shear-Wave Velocity Profiles Generated from Spectral Analysis Generated from Spectral Analysis of Surface Waves: Field Examples

Multi-channel surface-wave seismic data were acquired at six separate bridge sites in southeast Missouri (Figure 1). Each acquired surface wave data set was processed (spectral analysis of surface waves; SASW) and transformed into a site-specific vertical shear-wave velocity profile. A comparison of the SASW shear-wave profiles to other conventional geotechnical data indicates the SASW tool is a cost-effective and reliable technique for determining shear-wave velocities in shallow unconsolidated sediment in the Mississippi Embayment in southeast Missouri.

The SASW shear-wave velocity profiles generated for each bridge site were compared to other available geotechnical data, including borehole lithologic logs, seismic cone penetrometer test (SCPT) shear-wave velocity profiles (Figure 3), and cross-borehole (CH) shear-wave velocity profiles

The SASW shear-wave velocity profiles correlate well with subsurface lithology logs and available cross-borehole shear-wave velocity control. More specifically, clays, silts and sands exhibit relatively characteristic SASW-velocities, which increase almost monotonically (step-wise and incrementally) with increasing depth of burial (Figures 2 and 3).

The SCPT shear-wave profiles, in contrast, do not correlate very well with available borehole lithologic

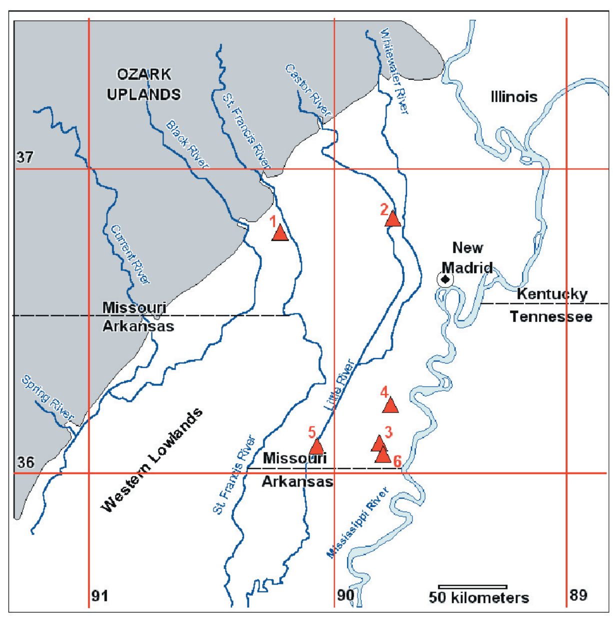

Figure 1
Map of Southeast Missouri Showing Locations of SASW Test Sites.

△ denotes SASW test site. (Site #1: A-3709 Bridge; Site #2: A5648 Bridge; Site #3: L-472 Bridge; Site #4: A-1466 Bridge; Site #5: L-302 Bridge; Site #6: A-5460 Bridge.)

Research Development and Technology

Missouri Department of Transportation

1617 Missouri Blvd.
P.O. Box 270
Jefferson City,
Missouri 65102

control, available cross-borehole shear-wave velocity profiles, or the SASW shear-wave velocity profiles (Figure 3). More specifically, SCPT shear-wave interval velocities often vary significantly over short vertical distances within essentially uniform lithologic units. In part, these variations are attributed to the inherent inaccuracy with which vertical acoustic travel times can be determined for thin (~1 m thick) layers.

On the basis of this comparative analysis, it is concluded that SASW shear-wave velocity profiles are reliable, and that the SASW technique is a cost-effective tool for determining the acoustic properties of soil in the Mississippi Embayment area, in southeast Missouri.

In terms of further research, additional SASW studies are recommended. More specifically, additional SASW, SCPT, cross-borehole seismic and SPT data should be acquired at multiple additional test sites in Missouri, in an effort to determine inter-relationships in a statistically meaningful way. SASW data should also be acquired at select sites in Missouri, in order to assess the utility of this tool as a means of determining depth to bedrock, estimating the engineering properties of bedrock, and identifying heterogeneities (e.g. karstic cavities) within bedrock. Lastly, SASW data should be acquired across paved roadways in order to assess the capabilities of this tool in terms of estimating asphalt and pavement thicknesses, and sub-grade conditions.

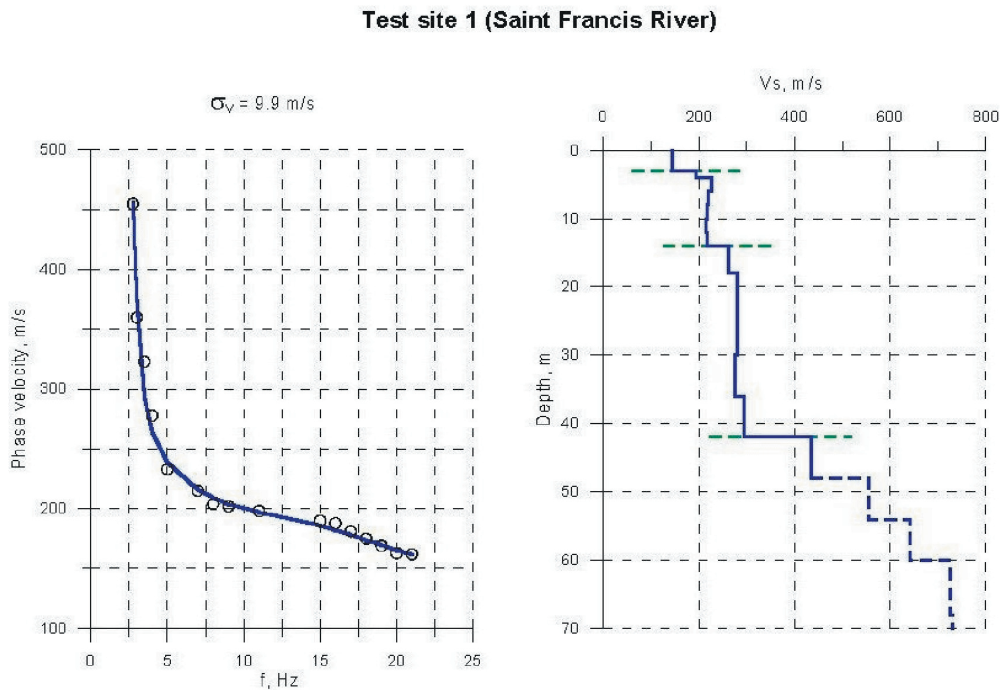

Figure 2
Phase Velocity Function for Test Site #1 (A-3709 Bridge) and Corresponding SASW Shear-wave Velocity Profile.

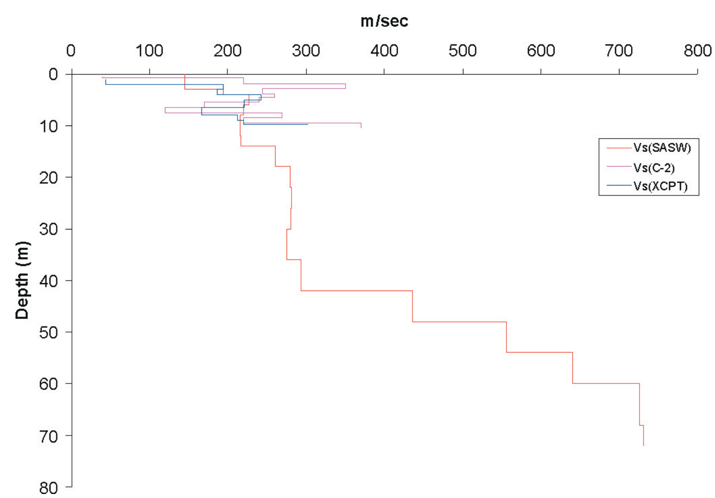

Figure 3
Shear-wave Velocity Profiles for Site #1 (A-3709 Bridge). Vs(SASW) - SASW Shear-wave Profile; Vs(C-2) - SCPT Shear-wave Velocity @ C-2 Site; Vs(Xcpt) - SCPT

For more information contact
Neil Anderson
University of Missouri – Rolla
(573) 341-4616
nanders@umr.edu